AmeriCorps New Jersey Watershed Ambassadors Program

Biological Assessment Quality Assurance Project Plan

New Jersey Department of Environmental Protection
Water Monitoring and Standards

February 26, 2016

QUALITY ASSURANCE SAMPLING PLAN
Biological Assessment Quality Assurance Project Plan

Project Manager

Jennifer Noblejas 2/26/16

Signature Date

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1.0 Project Name: Biological Assessment Quality Assurance Project Plan

2.0 QAPP Document Location: V:\lum\polplan\Envplan\Division of Watershed Management\OWEEM\AmeriCorps\NJWAP Program Files\Monitoring\QAPP

3.0 Requesting Agency: NJDEP, Water Monitoring and Standards

4.0 Project Fiscal Information: Job Number: 2AMERICX, Activity Codes: 2420; 2610; 3810

5.0 Project Manager: Jennifer Noblejas, Environmental Specialist 3, BEARS

6.0 Project Duration: September 1 thru July 31st each year

7.0 Special Training Needs/Certification

Each Ambassador will go through a multiday training program in September/October that will cover in detail macroinvertebrate collection techniques and macroinvertebrate identification. Before the Ambassadors are cleared to start their fall assessments, they must demonstrate proficiency in the sampling and identification procedures and techniques. The Ambassadors will be evaluated on their ability to correctly perform an assessment both at the conclusion of the training program and at their regional reference sites following training. In addition, before they perform any spring assessments, the Ambassadors will go to a macroinvertebrate refresher training program in March/April to reinforce the identification process and re-evaluate their macroinvertebrate identification skills.

8.0 Project Background

The AmeriCorps New Jersey Watershed Ambassadors Program (Program) is an environmental community service program administered by the New Jersey Department of Environmental Protection (Department) to raise public awareness about water and watershed issues and to promote watershed stewardship through direct community involvement. AmeriCorps is a part of the Corporation for National and Community Service, which engages more than 2 million Americans of all ages and backgrounds in community service each year. The Department began hosting the Program in September of 2000, under an AmeriCorps State contract with the Corporation for National and Community Service. Through this Program, AmeriCorps members are recruited on an annual basis and trained as "Watershed Ambassadors" (Ambassadors) to work with host agencies in each of New Jersey's twenty Watershed Management Areas (WMAs) to serve their watershed community. Part of that service includes coordinating and training the local community in assessments of local rivers and streams using both habitat and biological assessment protocols. The Program runs from September through July.

There are 18,126 river miles in the State of New Jersey. In the 2014 statewide water quality assessment, approximately 62% of the State's waters were assessed for biological health using a true biological indicator, leaving about 38% as unassessed based on

biology. Because of the number of river miles we have within the State, the Department relies on partners, volunteers and the Ambassadors to help fill our data gap needs for assessment. Each Ambassador performs a number of biological assessments throughout their WMA. The new stewardship level macroinvertebrate index developed for the specific ecoregions of NJ is used by the Ambassadors. These new indices will help the Department fill its assessment data gaps as it relates to biological assessments.

9.0 Project Description

Every year, the Ambassadors in the Program are required to complete biological assessments within their WMA between October and July. Sampling is performed at locations based on local and Department priorities in each WMA. Ambassadors collect samples by targeting riffles and/or best available in stream habitat. High gradient and low gradient streams are assessed differently based on their best available habitats for macroinvertebrates. Ambassadors use D-frame nets to collect samples in both high and low gradient areas. While collecting their biological samples, Ambassadors will also evaluate the stream bottom in their reach and will record habitat types. The Ambassadors must perform a habitat assessment with a biological assessment. At the conclusion of their sampling event, all Ambassadors must follow the proper protocols for decontaminating their equipment.

Ambassadors will record data from their biological assessments on the NJDEP Biological Assessment Sheet and submit the data onto the Biological Geoform on ArcGIS. Once all data is submitted for the year, the data will be quality assured as stated in the data validation section and uploaded into an internally maintained data management system.

FIELD MONITORING

10.0 Sampling Network and Design

Sampling will be performed within each of the 20 watershed management areas in New Jersey. Each ambassador is given a set of priority assignments based on the needs of the Bureau of Environmental Analysis, Restoration and Standards and previous ambassadors' recommendations. The remaining sites will be selected by each ambassador based on the needs of the community, host agency or their own inquiry.

Sampling Design Logistics:

Type of Sample/Parameter	Number of Samples	Sampling Frequency	Sampling Period	Sampling Locations
Biological	A minimum of 10	Members are given the option to submit 2 repeated assessments.	October – July	TBD in each WMA according to Department and local priorities

11.0 Sampling Procedures

11.1 General Procedures

See Biological Assessment Manual (see Appendix I)

11.2 Chain of Custody Form

Not Applicable as no lab work will be performed.

11.3 Cleaning Sampling Equipment

DIDYMO (Rock Snot) DECONTAMINATION

Treat all streams like they have Didymo, not just ones that have been confirmed. Didymo is not visible to the naked eye at first and by the time you see it, it is too late. When collecting macroinvertebrates from the stream, you must return them back to the same stream and the same location. No mixing samples. If you want to do more than one assessment in a day you should only work on one stream per day. Start upstream and work downstream when changing locations (following how the river flows), to avoid contaminating any upstream locations that have not been exposed to Didymo. You should clean your equipment after each day if working in the same stream or in between sampling events on different streams.

You must decontaminate all small equipment (e.g., buckets, nets, water sampling equipment) AND Personal Protective Equipment (e.g., rain gear, gloves, boots, waders and PFDs)

1. Remove all organic material from gear
2. Fill bucket with Alconox and stream water and place all equipment in the tub.
3. Scrub small and personal protective equipment.
4. Rinse or let dry completely

11.4 Equipment Calibration

Each of the Watershed Ambassadors is assigned sampling equipment which is thoroughly inspected by the AmeriCorps Program Manager/Staff before it is distributed at the beginning of the year. Each Watershed Ambassador is responsible for maintaining their assigned equipment. The Watershed Ambassadors are responsible for inspecting their nets for rips or tears and need to report any substantial damage to the AmeriCorps Program Manager so that an effort can be made to replace the damaged equipment. Any small rips or tears in the nets can be mended by the Watershed Ambassador. All equipment will be decontaminated after each use. This is a precautionary measure to cut down on the spread of invasive species from contact with one waterway to the next. Thermometers will be calibrated using the Temperature Calibration SOP at the beginning of the program. This calibration will occur every year at the beginning of field season. Thermometers that are off by 0.5 degrees or more will be discarded via lab procedures and replaced by the AmeriCorps Program Manager. Calibration logs will be filled out for each thermometer and saved by WMS staff.

12.0 Field Parameters

The parameters which will be measured on site include site location's latitude/longitude, air and water temperature, stream width, depth and velocity, habitat types, river bottom composition and macroinvertebrate counts. See Appendix I for Biological Assessment Manual.

13.0 Flow monitoring

Stream velocity will be measured. With a stopwatch, measure the time it takes your rubber duck to float the 10 feet section. Repeat 5 times using the same floating tool, in the same 10-foot section and record each time on your data sheet. Then average the 5 times to determine the average time. Divide the distance (D = 10 feet) by the average time (T) to determine velocity in feet per second (V = D/T). Convert to meters/second. Record this on your data sheet.

14.0 Field Quality Assurance and Quality Control

MEASUREMENT QUALITY OBJECTIVES

Parameter	Measurement Range	Accuracy	Precision
Geographic Coordinates via Smartphone and/or Google maps	± 90° N and ± 90° E depending on satellite availability	Unbiased	±100 feet
Biological Assessment Score	See Appendix E for Indices/Ratings	5 % margin of error allowed	
Macroinvertebrate ID QA/QC Check	See QC section	Within 5 % of known sample	
Thermometer	0 °C - 40 °C	Must be calibrated within +/- 0.5°C	0.1 °C
Reference Site Visits to verify field protocols	See Reference Site Locations table	Ambassador must not deviate significantly from appropriate techniques	

REFERENCE SITE LOCATIONS

Region	WMA	Lat	Long
Upper Delaware	11	40.619589	-75.077796

Northeast	6	40.768281	-74.532419
Raritan	8	40.737141	-74.622499
Lower Delaware	19	39.929073	-74.531229
Atlantic Coastal	13	40.095908	-74.320107

Biological Assessment Technique Quality Control (QC) Check

Ambassadors will be assessed on their biological sampling technique at their regional reference site visits in September/October to ensure they are following the proper protocol demonstrated at the trainings. This evaluation will occur after macroinvertebrate/habitat training and prior to the start of the biological/habitat assessment period and will be performed by Department/Program staff. If the Ambassador fails to demonstrate proficiency in the appropriate techniques, the Ambassador's data will not be considered for the Department's assessment purposes. The regional reference site visits surveys as the auditing process for the program.

Macroinvertebrate Identification QC Check

Ambassadors will have a lab practical during all the macroinvertebrate trainings where they will be tested on their macroinvertebrate identification skills. This evaluation will occur after macroinvertebrate training and prior to the start of the biological assessment period and will be performed by Department/Program staff. If an Ambassador fails to achieve at least 90% (less than 10% error), s/he will be required to take additional macroinvertebrate training. If the Ambassador is still struggling with the identification of macroinvertebrates, his/her data will not be considered for the Department's assessment purposes.

Data Representativeness

Each AmeriCorps member will be monitoring one of the 20 watersheds throughout the state. Within the state we have diverse land uses and three defined ecoregions: Coastal Plains, Pinelands and High Gradient. Land uses include rural, suburban and urban classifications. Each watershed differs depending on these ecoregions and land use classifications. The training designed for the Ambassadors has been tailored to cut down on regional biases as much as possible so sites across watershed boundaries are comparable to each other. Members are also individually evaluated to determine their accuracy in identifying the organisms used for the assessment protocol.

Data Comparability

Members are trained on how to collect, sort and analyze samples in accordance with NJDEP procedures. They are trained to identify the best possible habitat within their 100 meter stream reach for collection purposes. Because sorting macroinvertebrates to the order/family level is critical to properly scoring the stream segment, members are evaluated multiple times throughout the year. If a member fails the QA/QC check and does poorly on the lab review and pre and post testing for training, the NJDEP will

determine if the data collected is within the defined QA/QC requirements. Members not able to achieve the accuracy needed will still submit the data as needed for their requirements, however the data will not be used for assessment purposes and will be flagged.

Naming Sites

Members are asked to check whether a site has already been named by a previous Ambassador, USGS or is currently one of the Department's Bureau of Freshwater and Biological Monitoring's sites. Sites will be named in accordance with procedures documented in the Biological Assessment Manual. Site naming will be consistent for all monitoring activities.

Data Completeness

Data will be checked for completeness first by the AmeriCorps member prior to leaving the field assessment location. All fields will be checked to ensure they are filled out and the data sheet is complete. An incomplete web sheet will not count as an assessment towards their assessment goals for the program. Completeness will then be checked again when Ambassadors enter data onto the Biological Assessment Geoform. Data will not upload properly via the Geoform web system if fields are not filled in. NJDEP/Program staff will also review and check assessments to ensure they are complete and accurate.

15.0 Continuous Data Quality

Not applicable as no continuous data will be collected.

LABORATORY ANALYSIS

Not applicable as no lab work will be performed.

DATA MANAGEMENT / ASSESSMENT

Water quality data sampled under this project will be used in the water quality assessment of New Jersey waters. The AmeriCorps data will be used in the assessment of Aquatic Life General Designated Use and to fill data gaps for the Regional Comprehensive Assessments.

16.0 Equipment/Software Used To Handle Data

16.1 Purchase of equipment

Ambassadors currently are not required to utilize mobile devices to record data collected and observed in the field. The preferred data flow is to record results and measurements onto a hard copy datasheet. They then bring that datasheet back to the office to enter results into the OIRM supported Biological GeoForm application.

In the future, the Ambassador Program may pilot the use of mobile devices in the field for entering data into the Biological GeoForm. When and if this is decided to be the course of action, several devices will be purchased as a test case to evaluate the scalability of using this for the entire AmeriCorps Program. Along with the

mobile devices, the use of MiFi Wireless Routers will also be reviewed for flexibility and reliability in the field.

In order to successfully submit data to WQDE, a specific file structure prior to submission must be obtained. To do this, a copy of FMS's Total Access Statistics (TAS) software will be required. The Data Manager will work with the Project Manager to ensure a smooth transition in usage of this software. In the event that the Project Manager cannot obtain this software, the Data Manager will utilize the TAS software on their machine and send the Project Manager the customized file outputs that this software creates.

16.2 Collecting Data

The data will be recorded in the field using the biological assessment sheet. Once the field data is collected the Ambassadors must enter and submit their data into the Biological Geoform on ArcGIS. Geoform provides flexibility for the Ambassadors to enter and submit their data in the field as long as a wireless connection is available, or they can choose to enter the data at their office via a URL link.

17.0 Target Data Storage (Internal to Division)

17.1 Data owner

The Bureau of Environmental Analysis, Restoration and Standards will own the field data and manage the data internally.

17.2 Data storage

Data confirmed to be accurate in GeoForm will be uploaded into an internal MS Access storage system known as AmeriCorps. Once data exists in the AmeriCorps MS Access database, the Project Manager will make one final review of the data to ensure it's accurate. Throughout the entire process, the Project Manager may ask or request the Data Manager of this project for assistance in formatting, fixing, or identifying any issues discovered with the MS Access system.

Data storage for site specific location information will be handled between the Project and Data Manager. Due to the large volume of sample sites, site specific information will not be included in this QAPP, but an electronic file generated by the Project Manager will be given to the Data Manger to electronically transfer the information into the MS Access System.

18.0 Target Data Storage (External to Division)

Once data is confirmed to be accurate in the AmeriCorps database within BEARS, the data will be automatically formatted to be compatible with the Department's Water Quality Data Exchange (WQDE) system. Automated file format will occur within MS Access. The Data Manager for this project will ensure that the automated formatting of information to be compatible with WQDE happens accurately. Further, if any assistance is needed to submit these files to WQDE, the Data Manager will work with BEARS to troubleshoot or tweak files to ensure successful file submissions.

Once the data is submitted to WQDE, by default, it will then be sent to the Environemental Protection Agency's (EPA) Storage and Retrieval System (STORET). Then from this point, the data will be sent to the National Water Monitoring Council Water Quality Portal. The data then becomes Public once data resides in STORET and the WQ Portal.

Table X: URL links for data access

Data Source	Location	Internal	External
National Water Monitoring Council Water Quality Portal	http://www.waterqualitydata.us/		
EPA STOrage and RETrieval (STORET)	http://www.epa.gov/storet/dbtop.html		X
Water Quality Data Exchange (WQDE)		X	

18.3 Data Input into Data Storage Locations

Data will be updated into the MS Access System and WQDE once a year or on an as needed basis if there are issues with the original submission.

19.0 Data Validation

Review of the datasheets will be conducted by the Project Manager. If incomplete or inaccurate data appears to be submitted, the Project Manager will consult the Watershed Ambassador to request that the data be reviewed and corrected. Once the Project Manager is satisfied with the quality of data residing in GeoForm, they will work with the Data Manager of this project to move the records from GeoForm, to an internal MS Access database customized specifically for AmeriCorps. The Project Manager will check the data again once it is in the AmeriCorps database. The Project Manager will review and verify such things as the Site ID and name, site coordinates, data results are within acceptable ranges and flagging Ambassadors that do not pass the QA/QC tests.

Ambassadors will also submit hard copies of their assessments at the end of their term of service. Data that are incomplete or anomalous will be evaluated for their utility. Anomalous data will be scrutinized carefully to determine whether any portion of the data is valid, and whether questionable data can be rectified with follow-up field assessments by Program staff. Anomalous data which cannot be corrected or completed will be entered but will be flagged as preliminary and unverified data. Similarly, incomplete data will be flagged in the data sets as partial data records. Any data that does not match up with the configuration file will be rejected from the system.

19.1 Data Management QA Procedures

The Project Manager will review the submittals from the Geoform at the end of the year and will upload the data into the AmeriCorps database. The submittals that pass the QA check will be marked off and uploaded into the data management system. Those submittals that do not pass the QA check will not marked off so it is not uploaded into the data management system.

20.0 Supplemental Data

In addition to performing a biological assessment, the Ambassadors will record any pipes or ditches within their stream reach on the Pipe and Ditches Log. This will provide additional information to the outfall inventory for the stormwater program.

21.0 Data Reporting

Not Applicable

22.0 Assessment, Oversight, and Response

Ambassadors' performance is reviewed by the Project Manager. Follow up with Ambassadors regarding their performance will occur on an as-needed basis. Data will be evaluated and if errors in the submitted data are found, the Ambassador will be contacted for corrections. However, if the Ambassador has already exited the program, Department staff will correct data or flag it so it will not be used for assessment purposes. In addition, if members are not able to pass proficiency sampling and identification, Ambassadors' data will not be considered for assessment purposes. Ambassadors will always be given access to technical assistance from Department staff as needed.

In the occasion of a major weather event, the Ambassadors will be notified to cease all monitoring activities until cleared by the Department to resume sampling. If at any time equipment is lost, broken, or in need of replacement or repair, members should notify the AmeriCorps Program Manager. If regulated pollution incidents are observed by volunteers during their surveys, they will be instructed to report the pollution incident to the NJDEP hotline (1-800-WARN DEP) and any other appropriate agencies and alert Program staff of the problem for follow-up.

23.0 Data Usage

Water quality data sampled under this project will be used in the water quality assessment of New Jersey waters. All sampling procedures must be in conformance with NJDEP Volunteer Monitoring Program's Biological Assessment Manual.

24.0 Corrective Action

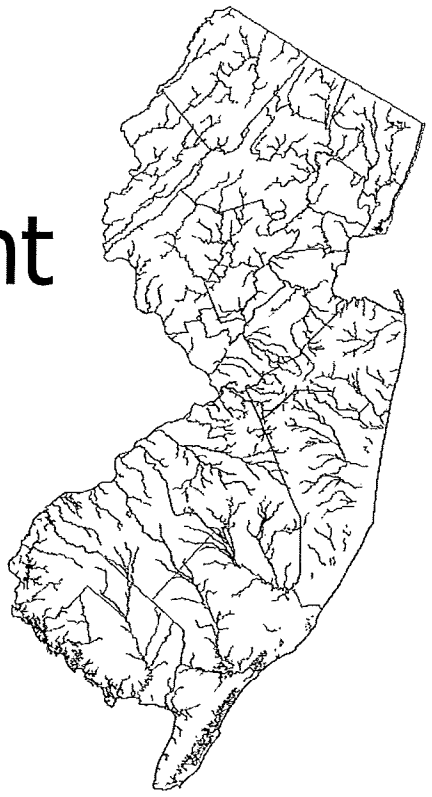
If a method or procedure requires change this information must be brought to the attention of the signatories of this QAPP through writing and needs approval prior to being used.

APPENDIX I:

New Jersey Department of Environmental Protection

NJDEP Volunteer Monitoring Program

Biological Assessment Manual



Volunteer Monitoring promotes a sense of stewardship and provides the community with the opportunity to become actively involved in the health of their local watershed.

A guide to filling out the NJDEP Volunteer Biological Monitoring Assessment

Visit us on the web for more info @
http://www.state.nj.us/dep/wms/bwqsa/vm/

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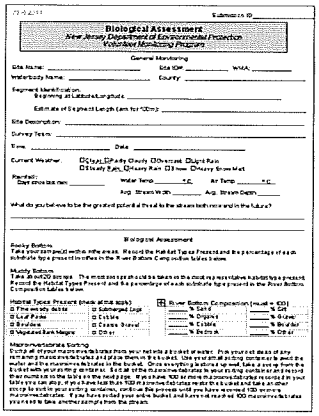
Filling out your Monitoring Packet

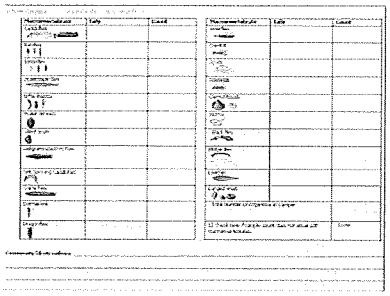
Each time you go out into the field to begin a biological assessment, make sure to have both pages of your biological monitoring packet; General and Macroinvertebrate Tally Sheet.
Fill out all sections in the field.


Biological Assessment
New Jersey Department of Environmental Protection
Volunteer Monitoring Program

The General Monitoring

This page identifies where you are performing your assessment and the weather conditions just before and during monitoring. This page also provides a description of the biological sorting process and how to properly collect macroinvertebrates depending on whether you are in a rocky or muddy bottom stream.

The Macroinvertebrate Tally Sheet

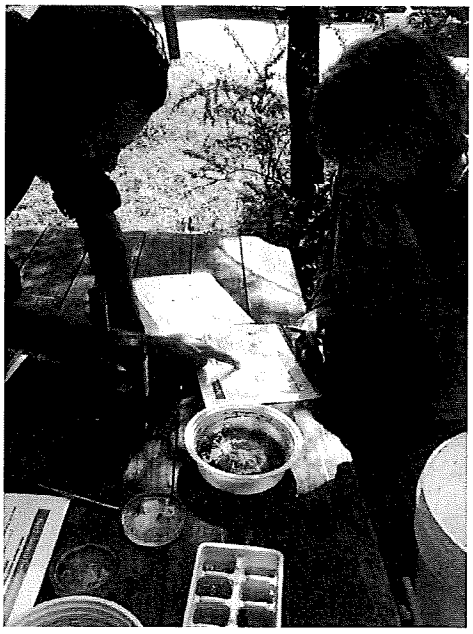


This page is designed to obtain specific biological data regarding the health of your stream. This section is to be completed stream side once you have collected your sample. After performing your biological assessment record the number of macroinvertebrates onto the tally sheet.

Before Heading into the Field

NJDEP is not liable for any event that occurs during monitoring.

1. Determine if it's the right time of year for monitoring especially if you plan to enter the stream
   - -Best times are spring, summer and fall
   - -Worst times are drought, extreme summer days and during flooding
   - -For safety reasons we do not recommend sampling during cold winter months



2. Confirm the time and location with your sampling partner
(Always monitor with another person!!)

3. Check to make sure you have all of your equipment before heading into the field

Suggested Equipment List

- ✓ Data Sheet
- ✓ GPS/Smartphone
- ✓ Clip Board and Pen/Pencil
- ✓ Measuring Tape and Meter Stick
- ✓ D-Frame Net
- ✓ Bug Identification Tools
  - Bug ID Card, Magnifying Glass
- ✓ Collection/Sorting Equipment

-D-frame net, Bucket Spoons, Small containers, Ice cube trays

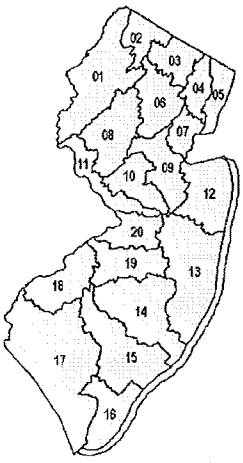
✓ Proper Attire (Waders, Boots, Long sleeves)

General Monitoring

Site Name and Site ID

Site Name: This is a unique name that you will give each site. The name you select should be descriptive and/or include the local name for the water body. Example, if you are going to a site on the Passaic River, your site name can be "Passaic River at intersection of Rt. 3 and Board St."

Site ID: The Site ID starts with WA (Watershed Ambassador) followed by the closest AMNET site or USGS station. Example: WA0689. Multiple assessments at the same AMNET location can be identified using a, b, c as you move upstream. Example: WA0689a. If there are no AMNET or USGS sites at the location and no other sites have been created by previous Ambassadors (you will need to check on NJ GeoWeb or ArcGIS before you go out in the field), you will use the first 4 letters of the stream. Example: Passaic River will be WAPASS. If the stream is named "Passaic Tributary", you can use WAPASSTRIB. If you are conducting multiple assessments you can use 1, 2, 3 as you move upstream. Example: WAPASS1.



Watershed Management Area & County

WMA: This refers to one of the 20 **W**atershed **M**anagement **A**reas identified by the Department. See the attached map. This information can also be obtained from NJ GeoWeb.

County: The name of the county you are doing the assessment in.

Segment Identification

Your stream reach should be no more than 100 meters.

Segment Beginning: Take a GPS point at the starting point of your assessment

Estimate of Segment Length: Estimate the length of the reach (aim for 100m)

Record the Latitude and Longitude on your data sheet.
You can also check accuracy of GPS points by identifying the latitude and longitude on a USGS topographic map, NJ GeoWeb, ArcGIS or Google Maps.

Survey Team, Activity Time & Date

Survey Team: Record the names of the people involved in the assessment. Remember, never conduct an assessment alone!
Activity Time & Date: Record the Date and Time when the assessment was performed.

Current Weather, Days Since Last Rain, & Temperature

Current Weather: Check the one that best describes the weather conditions on the day of the assessment as Clear, Partly Cloudy, Overcast, Light Rain/Showers, Steady Rain, Heavy Rain, Snow, Heavy Snow Melt.

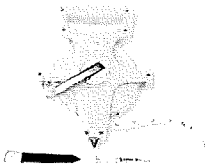
Days Since Last Rain:
Weather can affect assessment interpretation, so it is important to record recent rainfall or drought conditions. Record the number of days since the last rainfall in the space provided. If it hasn't rained within that week write one of the following: 'More than one week since last rain', OR 'More than one month since last rain'. You can also check the volunteer weather monitoring site at **http://www.cocorahs.org/** or Visit the National Weather Service at **http://water.weather.gov**.

Current Temperature: Enter the air and water temperature in °C. If you need to convert Fahrenheit to Celsius use the Converter at **http://www.wbuf.noaa.gov/tempfc.htm**.

Transect Measurements (Width, Depth & Velocity)

Using your flags, mark off a 10 foot section of stream that is representative of your stream reach. You should consider the average width of your stream by walking the whole 100m stretch first, then select an area that is accessible and representative of the stretch. Within this section, you will be measuring width, depth and calculating velocity.

Stream Width

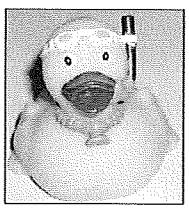


Measure the stream width using your surveyor's tape measure. Simply have one partner stay at the water's edge and the other partner walk directly across to the other water's edge and record the measurement. Take 1 measurement within the 10 foot section and record the measurement on the data sheet. Make sure to record the units you are using. Meter is the unit of choice for the data management system.

Stream Depth

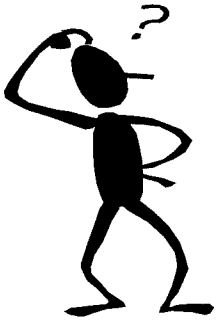
Take 5 depth measurements in your 10 foot section along the width transect. You should measure at least every foot for smaller streams and every five feet for wider streams. Calculate the **average** of the measurements and record it on your data sheet. Meter is the unit of choice for the data management system.

Stream Velocity



With a stopwatch, measure the time it takes your rubber duck to float the 10 feet section. Repeat 5 times using the same floating tool, in the same 10-foot section and record each time on your data sheet. Then average the 5 times to determine the average time. Divide the distance (D = 10 feet) by the average time (T) to determine velocity in feet per second (V = D/T). Convert to meters/second. Record this on your data sheet.

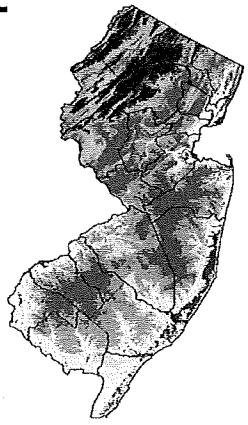
Watershed Health Question



What do you believe to be the greatest potential threat to the stream both now and in the future?

Look around your monitoring site and try to determine what things may be affecting the stream's health. For example, do you see a lot of litter, cows in the stream, or new construction around? Record your answer on the data sheet.

Biological Assessment Information



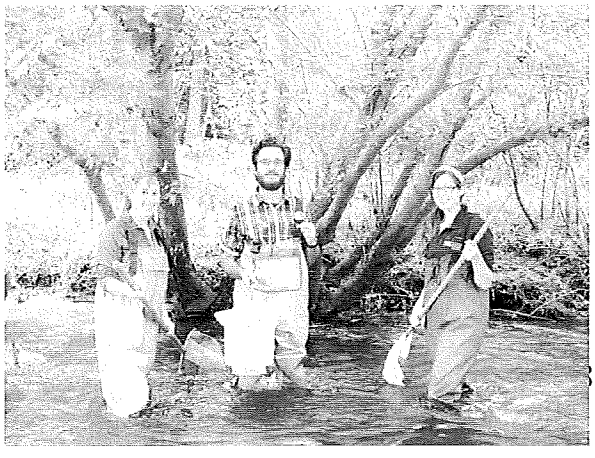
There are two predominate stream types, rocky bottom and muddy bottom. Rocky bottom streams are found in areas that are high above sea level like the Highlands or the Piedmont region. Muddy bottom streams are found in low-lying areas like the Coastal Plains or the Pinelands. The protocol you follow will depend on the type of stream that you are sampling.

Rocky Bottom

Stand in a riffle area with a D-Frame net facing upstream. Vigorously shuffle your feet and rub rocks with your hands in a one foot square area upstream of your net. When you feel that the upstream area has been thoroughly disturbed, carefully move your net over (or slightly upstream in the riffle section if your stream is very narrow) and repeat this process two more times in sequence (to equal an overall 3 foot square/one meter square area sampled) in the riffle. Pick up the net and rinse it off into a bucket, making sure to check the net for any remaining clinging organisms. Take several samples from different riffle areas in your stream reach (if possible/available) to make up your one overall sample.

Muddy Bottom

To collect your sample, you will be collecting a series of scoops. Break your scoops down into the following categories: woody debris, leaf packs, vegetated/undercut bank margins, submerged logs, cobble, coarse gravel, and other. If you are sampling undercut/vegetated banks, repeatedly jab your D-frame net vigorously into the



sampling habitat. If you are sampling woody debris/submerged logs, you will vigorously scrape the wood with your net. If you have leaf packs in your stream reach, you will rub them upstream of your net to dislodge any macroinvertebrates. To sample the substrate, whether coarse gravel or fine sediment, you will disturb a one foot square area upstream of your net, taking care not to collect too much sediment/debris.

When you believe the area has been disturbed thoroughly when targeting any of these habitats, swing your net back and forth several times to collect any organisms that may be suspended in the water column. That is considered one scoop. A good starting point is to take a total of 20 scoops. Make sure scoops are taken from each of the represented habitat types with the most scoops being taken from the habitat type most common/most productive in the sampling area. If your stream bottom is muddy or silty, you will not find a large diversity of macroinvertebrates in that area, so focus your scoops on more productive habitat types.

You may want to periodically empty your net into a bucket so that macroinvertebrates captured from previous scoops do not get out.

Hint: You may need to take samples up and down your 100 meter stream reach. Find the best habitat areas to sample within each stream reach and always face upstream to avoid losing any macroinvertebrates.

Best habitat refers to places where there are:
Woody debris, Leaf Packs, Boulders, Cobble, Logs, Vegetated Bank Margins

Habitat and River Bottom Composition

Habitat Types Present

Check the boxes that represent the different habitat types present within the stream

□ Fine woody debris	□ Submerged Logs
□ Leaf Packs	□ Cobble
□ Boulders	□ Coarse Gravel
□ Vegetated Bank Margins	□ Other

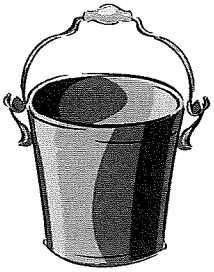
River Bottom Composition

Evaluate the stream bed in a riffle of your sampling reach. If you are in a muddy bottom area and don't have a riffle evaluate an area that is not a pool. Estimate the percentage of each of the following substrate types present and record your answer in the table on the data sheet. The numbers must add up to 100.

River Bottom Composition (must = 100%)

_____ % Sand	_____ % Silt
_____ % Organic	_____ % Gravel
_____ % Cobble	_____ % Boulder
_____ % Bedrock	_____ % Other

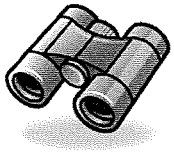
Macroinvertebrate Sorting



Dump all of your macroinvertebrates from your net into a bucket of water. Pick your net clean of any remaining macroinvertebrates and place them in the bucket. Use your small sorting container to swirl the water and the macroinvertebrates in the bucket. Once everything is stirred up well, take a scoop (sub-sample) from the bucket with your sorting container. Sort all of the macroinvertebrates in your sorting container (ice cube trays can help you to stay organized; each compartment can be a different group of organisms). Record the number and each type of macroinvertebrate you have sorted in the table on the next page. If you have 100 or more macroinvertebrates recorded in your table you can stop, if you have less than 100 macroinvertebrates re-stir the bucket and take another sub-sample to sort in your sorting container and continue this process until you have recorded 100 or more macroinvertebrates.

If you have sorted your entire bucket and have not reached 100 macroinvertebrates you need to take another sample from the stream. If after 20 minutes you have not found 25 macroinvertebrates you are to return to the stream to collect more macroinvertebrates to add to the bucket. If after 40 minutes of sorting you have not found 50 macroinvertebrates you are to return to the stream again to collect a third round of samples to add to the bucket. If after an hour and a half and three separate attempts to collect macroinvertebrates to add to the sample bucket you are still unable to sort and identify 100 macroinvertebrates, you will stop sorting and check the box on the assessment form indicating you were unable to find 100 macroinvertebrates.

Observations



Fill in any other observations made about the reach. This can include wildlife observed, anything that appears out of the ordinary or information obtained by talking with local residents concerning the history of the land in that area.

Macroinvertebrate Tally Sheet

After you have sorted 100 macroinvertebrates, tally and record totals on this sheet.

A Brief Introduction to Benthic Macroinvertebrates

Benthic macroinvertebrates are animals that lack backbones and are visible to the unaided eye, meaning they do not require magnification to be seen. We call them benthic when they live on the streambed or attach themselves to aquatic plants or floating wood. Common benthic macroinvertebrates include the larval stages of many insects – such as dragonflies, mayflies, and black flies – as well as permanent stream dwellers like mussels, crayfish, and snails.

The presence of benthic macroinvertebrates can tell us a lot about the health of a stream because each organism varies in its ability to tolerate pollution. Mayfly larvae, for example, are very sensitive to pollution and can only survive in clean water. Rat-tailed maggots, on the other hand, are relatively unaffected by pollution and can tolerate highly degraded waterways.

Most of the benthic macroinvertebrates found in New Jersey fall under one of three categories. These categories include pollution intolerant, pollution sensitive, and pollution tolerant. Pollution intolerant organisms can only survive in streams that contain little to no pollution. Pollution sensitive organisms can tolerate some pollution, but cannot live in heavily degraded waterways. Pollution tolerant organisms can survive in very polluted water. The chart below lists common benthic macroinvertebrates found in New Jersey and shows which category they fall under.

Pollution Intolerant	**Pollution Sensitive**	**Pollution Tolerant**
Mayfly Larva	Caddisfly Larva *(net spinning)*	Black Fly Larva
Stonefly Larva	Alderfly Larva	Midge Fly Larva
Caddisfly Larva *(case making)*	Damselfly Larva	Lunged Snail
Dobsonfly Larva/Hellgrammite	Dragonfly Larva	Aquatic Worm
Watersnipe Fly Larva	Crane Fly Larva	Leech
Riffle Beetle	Sowbug	
Water Penny	Scud	
Gilled Snail	Crayfish	
	Clam/Mussel	

Remember: a healthy stream will contain benthic macroinvertebrates from all three categories – it will not just include pollution intolerant organisms. Biological diversity is the key to a healthy stream!

Biological Assessment
New Jersey Department of Environmental Protection

General Sheet

*** Site ID:** _____ *** Watershed Management Area:** _____

*** Site Name:** _____ *** County:** _____

*** Segment Identification:** Latitude/Longitude: _____

Estimate of Segment Length (aim for 100m): _____

*** Survey Team:**

_____

*** Time:** _____ *** Date:** _____

Current Weather: Clear Partly Cloudy Overcast Light Rain
(Circle One) Steady Rain Heavy Rain Snow Heavy Snow Melt

Days since last rain: _____ **Air Temp** _____ ° C **Water Temp**_____ ° C

Transect: Avg. Stream Width _____meters Avg. Stream Depth _____meters

Velocity _____meters/second

What do you believe to be the greatest potential threat to the stream both now and in the future?

_____

_____

Biological Assessment

Rocky Bottom
Take your sample(s) within riffle areas. Record the Habitat Types Present and the percentage of each substrate type present in riffles in the River Bottom Composition tables below.

Muddy Bottom
Take about 20 scoops. The most scoops should be taken in the most representative habitat type present. Record the Habitat Types Present and the percentage of each substrate type present in the River Bottom Composition tables below.

Habitat Types Present (check all that apply)

- ☐ Fine woody debris
- ☐ Leaf Packs
- ☐ Boulders
- ☐ Vegetated Bank Margins
- ☐ Submerged Logs
- ☐ Cobble
- ☐ Coarse Gravel
- ☐ Other

River Bottom Composition (must = 100)

_____ % Sand
_____ % Organic
_____ % Cobble
_____ % Bedrock
_____ % Silt
_____ % Gravel
_____ % Boulder
_____ % Other

Macroinvertebrate Sorting
Empty all of your macroinvertebrates from your net into a bucket of water. Pick your net clean of any remaining macroinvertebrates and place them in the bucket. Use your small sorting container to swirl the water and the macroinvertebrates in the bucket. Once everything is stirred up well, take a scoop from the bucket with your sorting container. Sort all of the macroinvertebrates in your sorting container and record their numbers in the table on the next page. If you have 100 or more macroinvertebrates recorded in your table you can stop, if you have less than 100 macroinvertebrates re-stir the bucket and take another scoop to sort in your sorting container, continue this process until you have recorded 100 or more macroinvertebrates. If you have sorted your entire bucket and have not reached 100 macroinvertebrates you need to take another sample from the stream.

Macroinvertebrate	Tally	Count
Caddisflies 		
Mayflies 		
Stoneflies 		
Watersnipe Flies 		
Riffle Beetles 		
Water Pennies 		
Gilled Snails 		
Hellgrammite/Fish Flies 		
Net Spinning Caddisflies 		
Crane Flies 		
Damselflies 		
Dragonflies 		

Macroinvertebrate	Tally	Count
Alderflies 		
Crayfish 		
Scuds 		
Sowbugs 		
Clams/Mussels 		
Worms 		
Black flies 		
Midge flies 		
Leeches 		
Lunged snails 		
Check one: □ High Gradient □ Pinelands □ Coastal Plain	**Total Number of Organisms in Sample**	
Check here if sample count does not equal 100 macroinvertebrates.		Score: Rating:

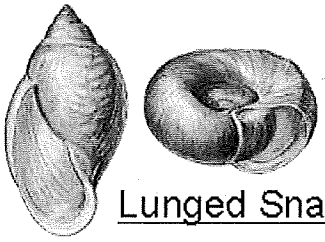
General Observations (Character limit 60):

Comments (Character limit 250):

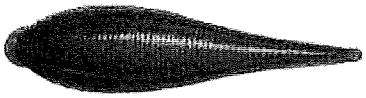
Macroinvertebrate Cheat Sheet

Flatworm/Planaria

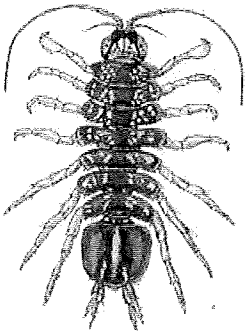
Gilled Snail



Lunged Snails

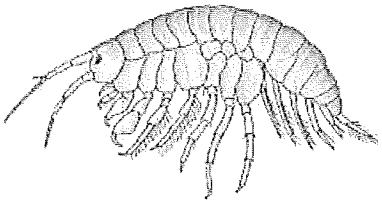


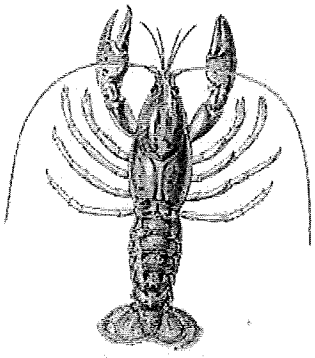
Leech



Sow Bug

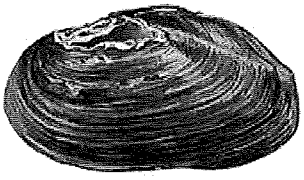
Scud



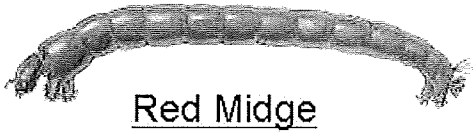


Cray Fish

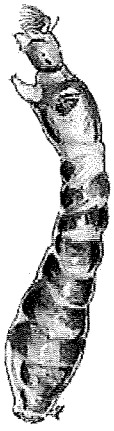
White Midge



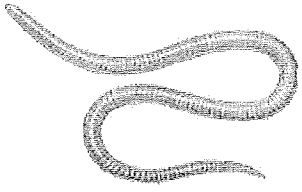
Mussel



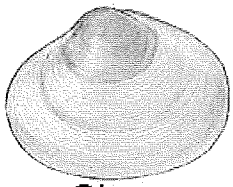
Red Midge



Black Fly Larvae



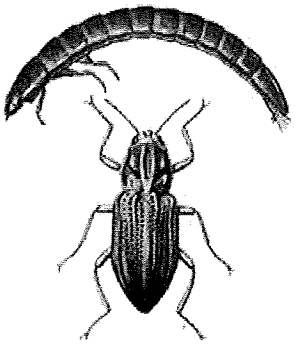
Aquatic Worm



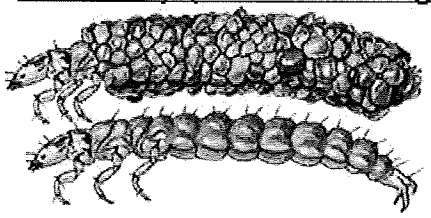
Clam

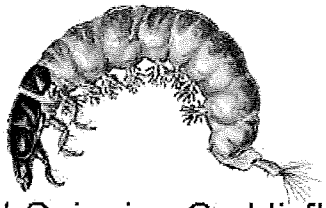
Macroinvertebrate Cheat Sheet

Riffle Beetle Larvae



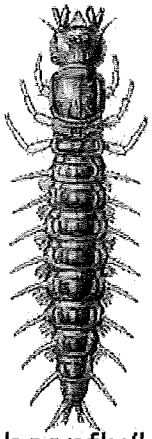
Caddisfly (Case Building)





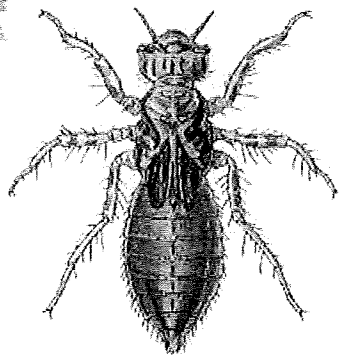
Net Spinning Caddisfly

Water Penny



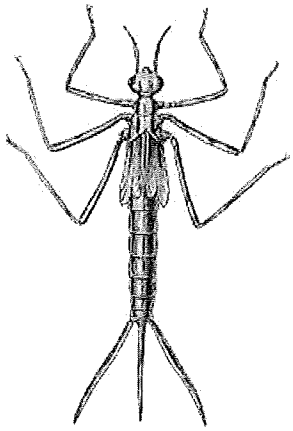
Water Snipe Fly

Crane Fly

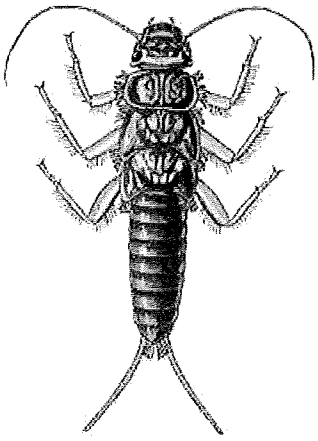


Dragonfly Nymph

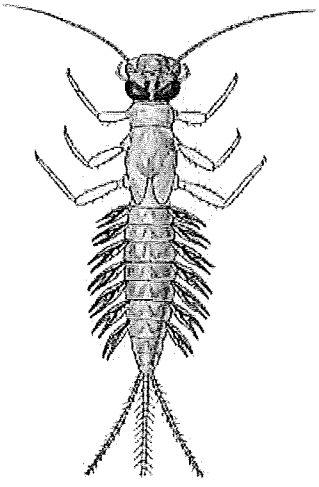
Dobsonfly/Hellgrammite



Damselfly Nymph



Stonefly Nymph



Mayfly Nymph

DIDYMO (Rock Snot) DECONTAMINATION

Treat all streams like they have Didymo, not just ones that have been confirmed.

Didymo is not visible to the naked eye at first and by the time you see it, it is too late.

When collecting macroinvertebrates from the stream, return them back to the same stream and the same location. No mixing samples.

If you want to do more than one assessment in a day you should only work on one stream per day. Start upstream and work downstream when changing locations (following how the river flows), to avoid contaminating any upstream locations that have not been exposed to Didymo.

You should be clean your equipment after each day in same stream or in between sampling events on different streams.

You must decontaminate all small equipment (e.g., buckets, nets, water sampling equipment) AND Personal Protective Equipment (e.g., rain gear, gloves, boots, waders and PFDs)

1. Remove all organic material from gear
2. Fill bucket with Alconox and stream water and place all equipment in the tub.
3. Scrub small and personal protective equipment.
4. Rinse or let dry completely

Glossary

Algae: A chlorophyll-containing plant ranging from one to many cells in size that lives in fresh or salt water.

Baseflow: The portion of stream flow that is derived from groundwater; average stream discharge during low flow conditions.

Benthic (Bottom-dwelling)**:** The plant and animal life whose habitat is the bottom of a sea, lake, or river.

Channelization: Straightening of a stream channel to make water move faster.

Channelized: The straightening and deepening of streams. Channelization reduces the ability of the stream to assimilate waste and disturbs fish breeding areas.

Culvert: A channel used for draining water, often enclosed in steel, concrete, or plastic; can be used to allow water to pass underneath a road or embankment.

Ecosystem: The interacting system of a biological community (plants, animals) and its non-living environment.

Effluent: The wastewater from a municipal or industrial source that is discharged into the water.

Embeddedness: The degree to which objects in the stream bottom are surrounded by sediment.

Erosion: The wearing away of the land surface by wind or water.

Eutrophication: A process where water bodies receive excess nutrients that stimulate excessive plant growth.

Floodplain: The flat area of land adjacent to a stream that is formed by flood processes.

Gradient: The slope or steepness of the stream.

Macrophytes: Aquatic plants, growing in or near water that are either emergent, submergent, or floating.

Macroinvertebrate: Organisms found attached to rocks or within the sediments of the stream bed, often larval stages of insects and are indicative of stream health.

Non-Point Source Pollution: "Diffuse" pollution, generated from large areas with no particular point of pollutant origin, but rather from many individual places. Urban and agricultural areas generate nonpoint source pollutants.

Nutrient: Any substance, such as fertilizer, phosphorus, and nitrogen compounds, which enhances the growth of plants and animals.

Point Source Pollution: A discharge of water pollution to a stream or other body of water, via an identifiable pipe, vent, or culvert.

Pool: An area of relatively deep slow water in a stream that offers shelter to fish.

Quality Assurance (QA): Quality Assurance is the larger system to see that Quality Control (QC) is maintained. QA asks if we are doing the right things (in our case are we monitoring the right things to detect changes in water quality).

Reach: A stream section with fairly similar characteristics.

Riffle: A shallow, gravely area of streambed with swift current where water is breaking over rocks, wood, or other partly submerged debris and producing surface agitation.

Riprap: A sustaining wall built of rocks.

Riparian Zone: An area, adjacent to and along a watercourse, which is often vegetated and constitutes
a buffer zone between the nearby lands and the body of water.

Run: A stretch of fast smooth current, deeper than a riffle.

Runoff: The portion of rainfall, melted snow, or irrigation water that flows across the ground surface and eventually returns to streams. Runoff can pick up pollutants from the air or the land and carry them to streams, lakes, and oceans.

Sediment: Fine soil or mineral particles that settle to the bottom of the water or are suspended in the water.

Stormwater Runoff: Water that washed off the land after a rainstorm. In developed watersheds it flows off of roofs and pavement into storm drains which may feed directly into the stream; often carries concentrated pollutants.

Substrate: The material that makes up the bottom layer of the stream, such as gravel, sand, or bedrock.

Suspended Sediments: Fine material or soil particles that remain suspended by the current until deposited in areas of weaker current. They create turbidity and when deposited, can smother fish eggs or early plant growth.

Topographic: The configuration of a surface area including its relief, or relative elevations, and the position of its natural and man-made features.

Turbidity: Cloudiness of the water, caused by suspended sediments or excess organic matter.

Volunteer Pinelands Macroinvertebrate Index

	Organisms A	Count B	% Crustacea & Mollusca Taxa C	# Insect Taxa D	# EPT / # Tolerant		# Tolerant Taxa H	% Worm, Leech, Lunged Snail I
					EPT Taxa E	Tolerant Taxa F		
	Pollution Intolerant							
1	Mayfly							
2	Stonefly							
3	Caddisfly (case-building)							
4	Hellgrammite/ Dobsonfly							
5	Watersnipe Fly*							
6	Riffle Beetle							
7	Water Penny*							
8	Gilled Snail							
	Pollution Sensitive							
9	Net-Spinning Caddisfly							
10	Alderfly							
11	Damselfly							
12	Dragonfly							
13	Crane Fly							
14	Sowbug							
15	Scud							
16	Crayfish							
17	Clams/Mussels							
	Pollution Tolerant							
18	Black Fly							
19	Midge Fly							
20	Lunged Snail							
21	Aquatic Worm							
22	Leech							
23	**Total Individuals**							
24	**Total Taxa**							
25	**Percent**							

* These macroinvertebrates are not found in the Pinelands

Check Box	Step	
	1	Column B- Record the number of individual organisms present in each group (taxa) in your sample. Record total number of individuals in box B23. [Aim for approximately 100 macros – you must have 100 macros +/- 10% (90-110 macros) in order for the VPMI to work]
	2	Column B- Total the number of taxa which had individual organisms present and record in box B24.
	3	Column C through H- Mark an X in each box where taxa for that category were present.
	4	Column C through H, box 24. Add together the number of Xs for each column and record sum in boxes C24-H24 for each respective category.
	5	Column I. Record the number of individual organisms in each taxa in this category in boxes I20-I22. Add totals in boxes I20-I22 and record in box I23.
	6	Divide the Total Taxa from Column C (box C24) by the Total Taxa from Column B (box B24) and multiply by 100 (C24/B24 * 100). Record this number in the Percent box of Column C (box C25)
	7	Divide the Total Individuals from Column I (box I23) by the Total Indivuals from Column B (box B23) and multiply by 100 (I23/B23 * 100). Record this number in the Percent box 25 of Column I
	8	Enter the numbers from the specified boxes into the formulas in the Metrics Table below and calculate the scores for each Metric
	9	Total the Score Column in the Metrics Table and record this number in the Total box of the Metrics Table. Divide this number by 5 to find the average Metrics Score.
	10	Compare the Average Score to the chart below to find your final stream score

Metrics Table (The scoring scale is 0 – 100. Direction of metric change with increasing stress is shown with + or – signs)

Metric #	Metric Name	Scoring Formula	Score	
1	Percent Crustacea & Mollusca Taxa (+)	100 * (47.2- C25) / (47.2-0)		
2	Number of Insect Taxa (-)	100 * D24 / 10		
3	Number of EPT Taxa/(Number of Tolerant Taxa + 1) (-)	100 * (E24/(F24+1))		
4	Percent Worm, Leech and Lunged Snail Individuals (+)	100 * (64.7 – I25) / (64.7-0)		
5	Number of Tolerant Taxa (+)	100 * (4- H24) / (4-2)		
			Total	**Average**

≤ 45	Stressed
46 - 74	Undetermined
≥ 75	Healthy

Volunteer Coastal Plains Macroinvertebrate Index

	Organisms A	Count B	# EPT Taxa C	% Non Insect Taxa D	Biotic Index E	% Intolerant Taxa G	% Worm, Leech, Lunged Snail H
	Pollution Intolerant						
1	Mayfly						
2	Stonefly						
3	Caddisfly (case-building)						
4	Hellgrammite/ Dobsonfly						
5	Watersnipe Fly						
6	Riffle Beetle						
7	Water Penny						
8	Gilled Snail						
	Pollution Sensitive						
9	Net-Spinning Caddisfly						
10	Alderfly						
11	Damselfly						
12	Dragonfly						
13	Crane Fly						
14	Sowbug						
15	Scud						
16	Crayfish						
17	Clams/Mussels						
	Pollution Tolerant						
18	Black Fly						
19	Midge Fly						
20	Lunged Snail						
21	Aquatic Worm						
22	Leech						
23	**Total Individuals**						
24	**Total Taxa**						
25	**Percent**						

Check Box	Step	
	1	Column B- Record the number of individual organisms present in each group (taxa) in your sample. Record total number of individuals in box B23. [Aim for approximately 100 macros – you must have 100 macros +/- 10% (90-110 macros) in order for the VCPMI to work]
	2	Column B- Total the number of taxa which had individual organisms present and record in box B24.
	3	Column C & D - Mark an X in each box where taxa for that category were present.
	4	Columns C & D - Total the X's in each column and record in boxes C24 & D24, respectively.
	5	Column D – Calculate the % non-insect taxa: box D24/ box B24*100. Enter result in Box D25.
	6	Column E- For each taxa present in the Pollution Intolerant Category enter a score of 2. For each taxa present in the Pollution Sensitive Category enter a score of 1.
	7	Column E- Add the total (all of the 2s and 1s) for Column E and record in box E24 (this is not Total Taxa but rather Taxa Score Total)
	8	Column G – Place an X in each box where taxa for that category were present.
	9	Column G –Total the X's in Column G and record in box G24.
	10	Column G – Calculate the % Intolerant taxa: box G24/ box B24*100. Enter result in box G25.
	11	Column H – Record the number of individuals present for each taxa in this category. Add total and record in box H23
	12	Column H – Calculate the % Worm, Leech and Lunged Snail: box H23/ box B23*100. Enter result in box H25.
	13	Enter the numbers from the specified boxes into the formulas in the Metrics Table below and calculate the scores for each Metric
	14	Total the Score Column in the Metrics Table and record this number in the Total box of the Metrics Table. Divide this number by 5 to find the Average Metrics Score.
	15	Compare the Average Score in the Metrics Table to the chart below to find your final stream score.

Metrics Table (The scoring scale is 0 – 100. Direction of metric change with increasing stress is shown with + or – signs)

Metric #	Metric Name	Scoring Formula	Score	
1	Number of EPT Taxa (-)	100 * C24 / 3		
2	Percent NonInsect Taxa (+)	100 * (62.5- D25) / (62.5-16.67)		
3	Beck's Biotic Index (-)	100 * E24 / 14 (if score > 100, use 100 as default score)		
4	Percent Intolerant Taxa (-)	100 * G25 / 44.4		
5	Percent Worm, Leech and Lunged Snail Individuals (+)	100 * (46.2- H25) / (46.2-1.85)		
			Total	Average

≤ 35	Stressed
36-64	Undetermined
≥ 65	Healthy

Volunteer High Gradient Macroinvertebrate Index

	Organisms A	Count B	Biotic Index C
	Pollution Intolerant		
1	Mayfly		
2	Stonefly		
3	Caddisfly (case-building)		
4	Hellgrammite/Dobsonfly		
5	Watersnipe Fly		
6	Riffle Beetle		
7	Water Penny		
8	Gilled Snail		
	Pollution Sensitive		
9	Net Spinning Caddisfly		
10	Alderfly		
11	Damselfly		
12	Dragonfly		
13	Crane Fly		
14	Sowbug		
15	Scud		
16	Crayfish		
17	Clams/Mussels		
	Pollution Tolerant		
18	Black Fly		
19	Midge Fly		
20	Lunged Snail		
21	Aquatic Worm		
22	Leech		
23	**Total**		

Check Box	Step	
	1	Column B- Record the number of individual organisms present in each group (taxa) in your sample. Record total number of individuals in box B23 [Aim for approximately 100 macros – you must have 100 macros +/- 10% (90-110 macros) in order for the VPMI to work]
	2	Column C- For each taxa present in the Pollution Intolerant Category enter a score of 3. For each taxa present in the Pollution Sensitive Category enter a score of 2. For each taxa present in the Pollution Tolerant Category enter a score of 1.
	3	Column C- Add the total for Column C and record in box C23.
	4	Compare the Total from Column C to the chart below to find your stream rating.

0 - 12	Stressed
13 - 19	Undetermined
≥ 20	Healthy

APPENDIX D: TIME TABLES

Project:

Activity	Projected Start Date	Anticipated Date of Completion
Member trainings	September and March/April	September and March/April
Member QC Check	September and March/April	October and March/April
Data collection	October	July

Training Logistical Arrangements:

Type of Volunteer Training	**Who Will Conduct Training**	**Frequency of Training/Certification**
Biological Sampling Techniques	NJDEP Staff/Stroud Water Research Center/ Stony-Brook Millstone Watershed Association	Twice per program year: once during orientation and following orientation
Macroinvertebrate Identification	NJDEP Staff/Stroud Water Research Center/ Stony-Brook Millstone Watershed Association	At least twice per program year: once during orientation and following orientation

Sampling Design Logistics:

Type of Sample/Parameter	**Number of Samples**	**Sampling Frequency**	**Sampling Period**	**Sampling Locations**
Biological	A minimum of 10	Members are given the option to submit 2 repeated assessments.	October – July	TBD in each WMA according to Department and local priorities

APPENDIX E: REGIONAL INDICES

Volunteer Coastal Plains Macroinvertebrate Index (VCPMI):

Metric #	Metric Name	Scoring Formula
1	Number of EPT Taxa (-)	100 * metric #1 / 3
2	Percent NonInsect Taxa (+)	100 * (62.5- metric # 2) / (62.5-16.67)
3	Beck's Biotic Index (-)	100 * metric #3 / 14 (if score >100, use 100 as default score)
4	Percent Intolerant Taxa (-)	100 * metric #4 / 44.4
5	Percent Worm, Leech and Lunged Snail Individuals (+)	100 * (46.2- metric #5) / (46.2-1.85)

Volunteer Pinelands Macroinvertebrate Index (VPMI):

Metric #	Metric Name	Scoring Formula
1	Percent Crustacea & Mollusca Taxa (+)	100 * (47.2- metric # 1) / (47.2-0)
2	Number of Insect Taxa (-)	100 * metric #2 / 10
3	Number of EPT Taxa/(Number of Tolerant Taxa + 1) (-)	100 * metric # 3 / 1
4	Percent Worm, Leech and Lunged Snail Individuals (+)	100 * (64.7 - metric # 4) / (64.7-0)
5	Number of Tolerant Taxa (+)	100 * (4- metric # 5) / (4-2)

Volunteer High Gradient Macroinvertebrate Index (VHGMI):

Metric #	Metric Name	Scoring Formula
1	Biotic Index	$\sum$ [Pollution Intolerant Taxa (score 3), Pollution Sensitive Taxa (score 2) and Pollution Tolerant Taxa (score 1)]

Ratings:

	VCPMI	VPMI	VHGMI
Stressed	≤ 35	≤ 45	≤ 12
Undetermined	36-64	46-74	13-19
Healthy	≥ 65	≥ 75	≥ 20

* Please refer to Stewardship-Level Macroinvertebrate Index Development for Northern New Jersey High Gradient, Pinelands and Coastal Plain Streams at: http://www.state.nj.us/dep/wms/bwqsa/vm/docs/draft_tetra_tech_report_20100310.pdf

APPENDIX F: MEASUREMENT QUALITY OBJECTIVES

Parameter	Measurement Range	Accuracy	Precision
Geographic Coordinates via Smartphone and/or Google maps	± 90° N and ± 90° E depending on satellite availability	Unbiased	±100 feet
Biological Assessment Score	See Appendix E for Indices/Ratings	5 % margin of error allowed	
Macroinvertebrate ID QA/QC Check	See QC section	Within 5 % of known sample	
Thermometer	0 °C - 40 °C	Must be calibrated within +/- 0.5°C	0.1 °C
Reference Site Visits to verify field protocols	See QC section	Ambassador must not deviate significantly from appropriate techniques	

Data Representativeness

Each AmeriCorps member will be monitoring one of the 20 watersheds throughout the state. Within the state we have diverse land uses and three defined ecoregions: Coastal Plains, Pinelands and High Gradient. Land uses include rural, suburban and urban classifications. Each watershed differs depending on these ecoregions and land use classifications. The training designed for the Ambassadors has been tailored to cut down on regional biases as much as possible so sites across watershed boundaries are comparable to each other. Members are also individually evaluated to determine their accuracy in identifying the organisms used for the assessment protocol.

Data Comparability

Members are trained on how to collect, sort and analyze samples in accordance with NJDEP procedures. They are trained to identify the best possible habitat within their 100 meter stream reach for collection purposes. Because sorting macroinvertebrates to the order/family level is critical to properly scoring the stream segment, members are evaluated multiple times throughout the year. If a member fails the QA/QC check and does poorly on the lab review and pre and post testing for training, the NJDEP will determine if the data collected is within the defined QA/QC requirements. Members not able to achieve the accuracy needed will still submit the data as needed for their requirements, however the data will not be used for assessment purposes and will be flagged.

Naming Sites

Members are asked to check whether a site has already been named by a previous Ambassador, USGS or is currently one of the Department's Bureau of Freshwater and Biological Monitoring's sites. Sites will be named in accordance with procedures documented in the Biological Assessment Manual. Site naming will be consistent for all monitoring activities.

Data Completeness

Data will be checked for completeness first by the AmeriCorps member prior to leaving the field assessment location. All fields will be checked to ensure they are filled out and the data sheet is complete. An incomplete web sheet will not count as an assessment towards their assessment goals for the program. Completeness will then be checked again when Ambassadors enter data onto the Biological Assessment Geoform. Data will not upload properly via the Geoform web system if fields are not filled in.

APPENDIX G: INSTRUMENT/EQUIPMENT TESTING, CALIBRATION, INSPECTION AND MAINTENANCE REQUIREMENTS

Each of the Watershed Ambassadors is assigned sampling equipment which is thoroughly inspected by the Program Manager before it is distributed at the beginning of the year. Each Watershed Ambassador is responsible for maintaining their assigned equipment. The Watershed Ambassadors are responsible for inspecting their nets for rips or tears and need to report any substantial damage to the program manager so that an effort can be made to replace the damaged equipment. Any small rips or tears in the nets can be mended by the Watershed Ambassador.

All equipment will be decontaminated after each use. This is a precautionary measure to cut down on the spread of invasive species from contact with one waterway to the next. Decontamination protocol is outlined in the Biological Assessment Manual.

Thermometers will be calibrated using the Temperature Calibration SOP at the beginning of the program. This calibration will occur every year at the beginning of field season. Thermometers that are off by 0.5 degrees or more will be discarded via lab procedures and replaced by the Program Manager. Calibration logs will be filled out for each thermometer and saved by WMS staff.

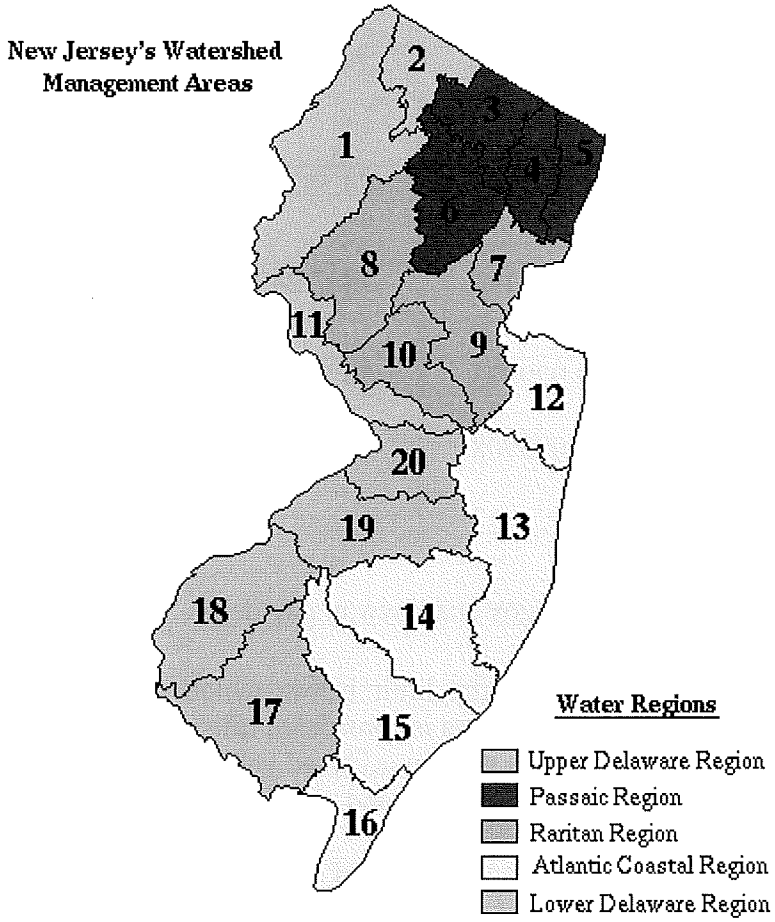
APPENDIX H: DATA REPORTING, REVIEW AND VERIFICATION

Review of the datasheets will be conducted by the Project Manager. If incomplete or inaccurate data appears to be submitted, the Project Manager will consult the Watershed Ambassador to request that the data be reviewed and corrected. Once the Project Manager is satisfied with the quality of data residing in GeoForm, they will work with the Data Manager of this project to move the records from GeoForm, to an internal MS Access database customized specifically for AmeriCorps. The Project Manager will check the data again once it is in the AmeriCorps database. The Project Manager will review and verify such things as the Site ID and name, site coordinates, data results are within acceptable ranges and flagging Ambassadors that do not pass the QA/QC tests.

Ambassadors will also submit hard copies of their assessments at the end of their term of service. Data that are incomplete or anomalous will be evaluated for their utility. Anomalous data will be scrutinized carefully to determine whether any portion of the data is valid, and whether questionable data can be rectified with follow-up field assessments by Program staff. Anomalous data which cannot be corrected or completed will be entered but will be flagged as preliminary and unverified data. Similarly, incomplete data will be flagged in the data sets as partial data records. Any data that does not match up with the configuration file will be rejected from the system.

If regulated pollution incidents are observed by volunteers during their surveys, they will be instructed to report the pollution incident to the NJDEP hotline (1-800-WARN DEP) and any other appropriate agencies and alert Program staff of the problem for follow-up.

APPENDIX I: MAP OF WMAs



APPENDIX J: REFERENCE SITE LOCATIONS

Region	WMA	Lat	Long
Upper Delaware	11	40.619589	-75.077796
Northeast	6	40.768281	-74.532419
Raritan	8	40.737141	-74.622499
Lower Delaware	19	39.929073	-74.531229
Atlantic Coastal	13	40.095908	-74.320107

APPENDIX K: GLOSSARY (from www.epa.gov and www.nj.gov/dep)

1. Acceptance criteria - criteria that specify the limit below which data quality is not considered satisfactory and above which the data is considered satisfactory
2. Accuracy - how well a measurement agrees with an accepted value or acceptance criteria; the degree of agreement between an observed value and an accepted value; a data quality indicator
3. Assemblage - the association of interacting organisms of a given population in a specific waterbody
4. Bias - the distortion of a measurement that disrupts the representativeness
5. Biological Assessment/ Bioassessment – an evaluation of the condition of a waterbody using biological surveys and other direct measurements of the resident biota in the waters
6. Biological integrity – the condition of an aquatic community inhabiting unimpaired waterbodies of a specified habitat by an assessment of multiple attributes of the aquatic biota; such attributes include (1) the product of the evolutionary process for the specific location, (2) inclusive of a broad range of ecological characteristics such as species richness and trophic level, and (3) is found in the biogeographic region of the study
7. Biomonitoring – multiple, routine biological assessments over time using consistent sampling and analysis methods for detection of changes in biological condition
8. Calibration – a procedure which checks or adjusts an instrument's accuracy by comparison with a standard or reference
9. Comparability – the degree to which different methods and/or data sets agree or can be represented as similar; the ability to describe likenesses and differences in the quality and relevance of two or more data sets; a data quality indicator
10. Completeness – the amount of valid data obtained compared to the planned amount; usually expressed as a percentage; a data quality indicator
11. Confidence interval – an interval that has the stated probability of containing the true value of a fixed, but unknown, parameter

12. Confidence level – the level of certainty which an estimate can be trusted; the probability, usually expressed as a percentage, that a confidence interval will include a specific population parameter; usually range from 90 to 99 percent
13. Data Quality Objectives (DQO's) – qualitative and quantitative statements developed by data users to specify the quality of data needed to support specific decisions; describe the decision to be made, what data are required, why they are needed, that calculations in which they will be used, and time and resource constraints
14. Indicator – characteristics of the environment, both abiotic and biotic, that provide quantitative information on ecological resources
15. Measured value - the result of an individual's measurement of a quantifiable property
16. Precision - how well a series of measurements agree with each other; it may be determined by calculating the standard deviation, or relative difference, among samples taken from the
17. Qualitative data- information that is difficult to measure, count, or express numerically; the attributes, behavior, or opinions of the entity being measured; descriptive in character; subjective
18. Quality Assurance (QA) - an overall management plan to ensure the integrity of data
19. Quality Assurance Project Plan (QAPP) – a written document describing the Quality Assurance procedures, Quality Control specifications, and any other technical activities that must be followed to ensure the results of a project or task performed will meet project specifications
20. Quality Control (QC) - a series of analytical measurements used to assess the quality of analytical data
21. Quality objectives – the upper and lower limiting values of data quality indicators as defined by the data user's acceptable error boundaries
22. Quantitative data – information that can be measured, counted, expressed numerically, or compared on a scale; non-subjective
23. Raw data – data that have not been manipulated in any way
24. Reference condition – the set of selected measurements or conditions of a minimally impaired waterbody that is characteristic of a waterbody in certain region
25. Reference site – a specific location on a waterbody that is minimally impaired and is representative of the expected ecological integrity of other waterbodies nearby
26. Representativeness - the degree to which data accurately and precisely represent the frequency distribution of a specific variable in the population; a data quality indicator
27. True value - the known acceptable value of a quantifiable property
28. Validation – the process of substantiating specified performance criteria; the evaluation of data beyond method, procedural, or contractual compliance to determine the analytical quality of a specific data set
29. Verifiable – the ability to be proven

APPENDIX L: FLAGGED DATA NOT MEETING QA/QC REQUIREMENTS

APPENDIX M: GPS LOG EXAMPLE

Site ID	Water Body	Monitoring Location Name	HUC 14	Lat	Long	Type	Score	Notes	Date	Coordinates verified? (Y/N)
WABBT02	Black Brook Tributary	343 Southern Blvd, Chatham	02030103010060	40.73677	-74.4228	Visual	130	Multiflora rose, littered pipes, golf trash	10/10/2013	Y
WASILV01	Silver Brook	In GSWA Conservation Management Area, Tiger Lily Lane, Morristown	02030103010030	40.762716	-74.496127	Biological	14	Very straight stream	7/3/2014	Y
WA080218I	Bayne Brook	Bayne Park Pond Outlet, Glen Alpin Road, Harding	02030103010030	40.74658	-74.49573	Visual	87	Mowing to about 1-2 meters outside of stream	6/26/2014	Y
WA080218I	Bayne Brook	Bayne Park Pond Outlet, Glen Alpin Road, Harding	02030103010030	40.74658	-74.49573	Biological	9	Many water fleas/mites	6/26/2014	Y
WA09 233	Whippany River	Patriot's Path, just downstream of bridge, across Sunrise Lake in Lewis Morris Park	02030103020020	40.789646	-74.546191	Visual	173	High water due to recent rain event	5/1/2014	Y

APPENDIX II

NJDEP Volunteer Monitoring
Thermometer Calibration SOP

Thermometers should be calibrated once a year.

Materials:

- Thermometers to be calibrated
- NIST thermometer with updated certificate
- Wide container to hold water at least eight inches deep
- Calibration Log:
- Ice
    - V:\lum\WM&S\WQSA Files\Volunteer Monitoring\Volunteer Monitoring\QAPP\Temperature QAPP\Calibration Event Log

Set-up

- Fill the container with room temperature water. The water must be within the range of 21°C and 29°C
- Place the NIST thermometer and all the thermometers to be calibrated in the water.
- Allow five minutes or so to pass so that the thermometers can stabilize
- Fill in the top section of the Calibration Event Log. Record the information about the thermometer's owner, the serial number for the NIST and the date it expires, also record the name(s) of the people performing the calibration

Lab

* It is helpful to have two people for the lab portion of the calibration, one to call out the readings from the thermometers and the other to record. Because your hands will get wet it is sometimes frustrating to read and record on your own.

25°C

- Select one of the thermometers to be calibrated and record the thermomter's unique ID on the Calibration Event Log.
- Read the temperature on the NIST thermometer and record in the 25°C row of the first table of the Calibration Event Log under the column "NIST Reading"
- Record the NIST correction listed on the NIST certificate under "NIST Correction"
- Read the temperature on the thermometer being calibrated and record in the 25°C row under "Field Reading"
- Repeat each step filling in a new table on the Calibration Event Log for each of the thermometers to be calibrated

0°C

- Place the NIST thermometer in a safe location and pour about 1/4 of the water out of the container you are using to calibrate and add ice to return the water level to the original volume
- Give the ice a few minutes to drop the water temperature and then check the temperature using the NIST thermometer. The temperature must drop below 8**°C** before you can begin the next step. Add more ice if necessary.

- Repeat each step from the 25°C section, but this time fill in the 0°C row of each table, making sure to match the thermometer ID to the table you are recording in.

Calculations

- Open the following Excel file:
  - V:\lum\WM&S\WQSA Files\Volunteer Monitoring\Volunteer Monitoring\QAPP\Temperature QAPP/ Calculation Program
- Fill out the Excel sheet by following the highlighted examples
- You will only have to enter the NIST Corrections once and they will be copied throughout the rest of the table.
-

Certificate

- Copy the table you created in Excel into the Certificate file located here (paste your new table over the table given as an example):
  - V:\lum\WM&S\WQSA Files\Volunteer Monitoring\Volunteer Monitoring\QAPP\Temperature QAPP\Certificate Ex
- Fill in the date of calibration, date of expiration, and the name of the organization the thermometers were tested for
- It is easier to read the table within the certificate if you turn the gridline on.
- Place a * next to any thermometer ID that has a correction of more than one degree. The * shows that we recommend the thermometer be replaced.
- Print the certificate off and sign the bottom
- Make a copy for our records and give the original to the organization that owns the thermometers.